

Unmanned Aerial Vehicle Battlelab & Air Force Research Laboratory

STORK Initiative

UAV Control and Emplacement of Robotic Vehicles in Urban Operations

**Maj Tim Schulteis
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**This Briefing
is Classified:**

UNCLASSIFIED



Overview

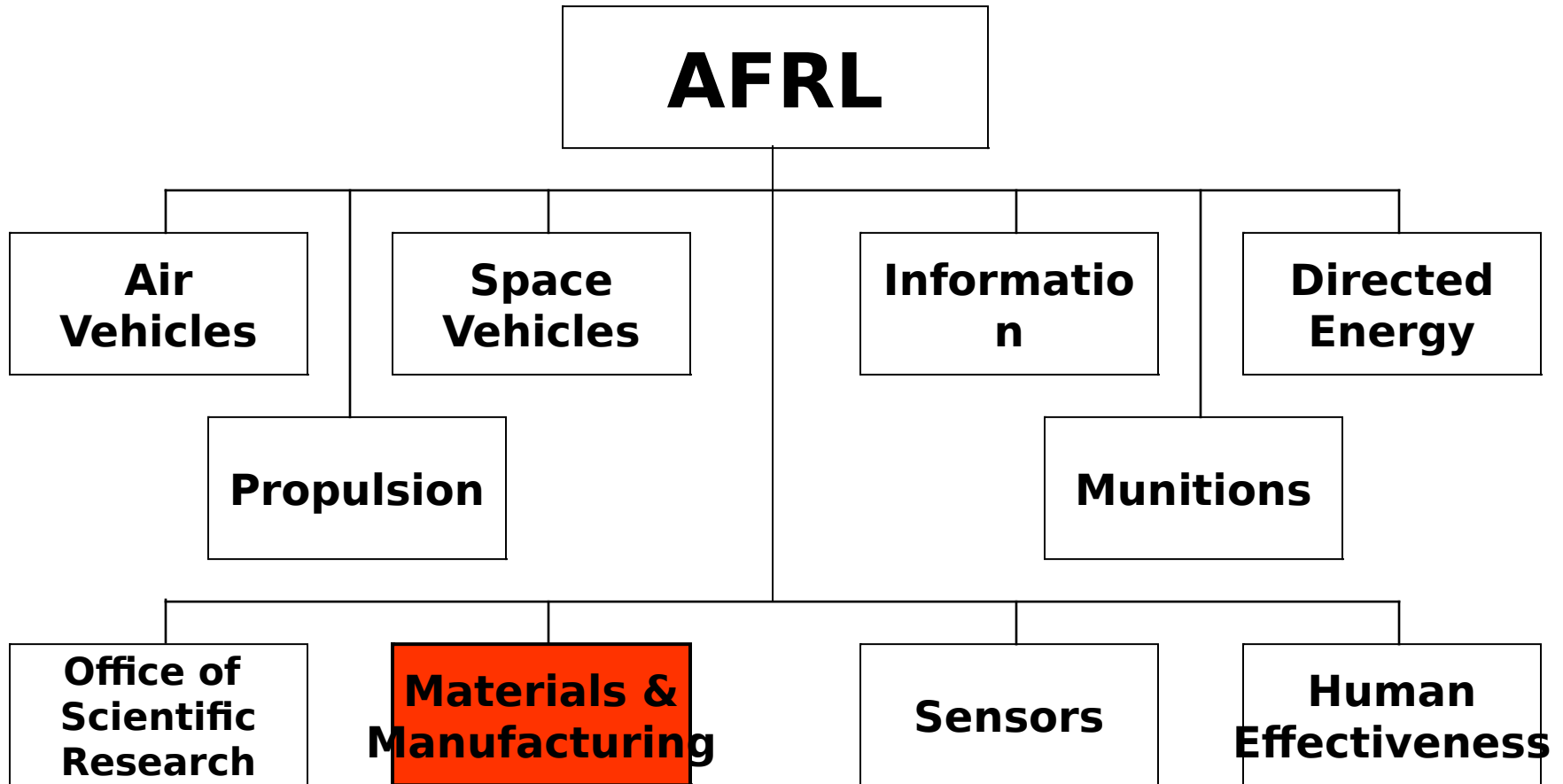


- **AFRL Organization**
- **Background**
- **Objectives**
- **System Architecture**
- **Equipment**
- **Comm-Relay**
- **Testing**
- **Results**



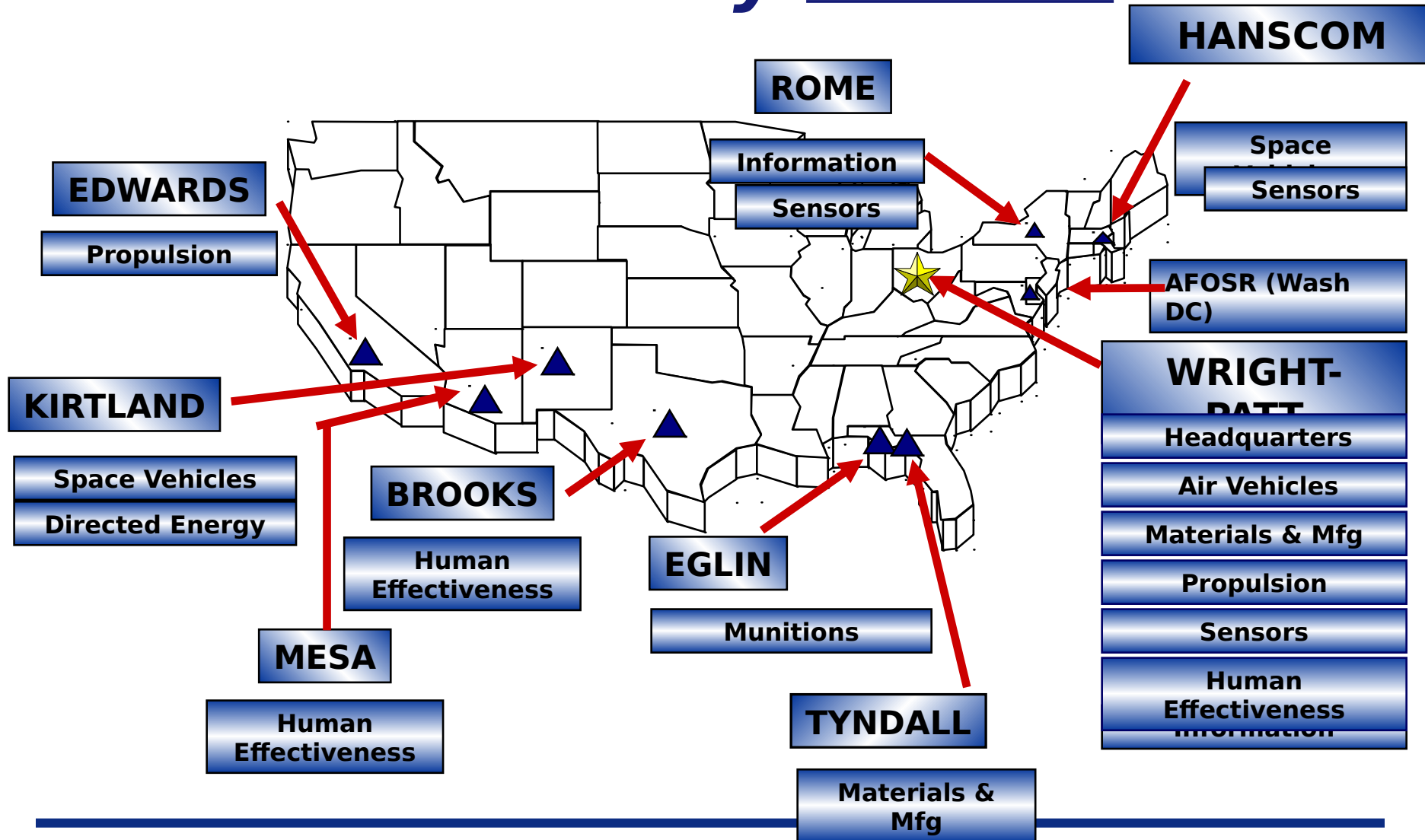
Air Force Research Laboratory

TECHNOLOGY DIRECTORATES





Air Force Research Laboratory LOCATIONS





Air Force Research Laboratory



Airbase Technologies Division (MLQ) Tyndall AFB

**Operations
Support Branch
(MLQO)**

**Chemistry and
BioTechnology Branch
(MLQL)**



**Deployed Base
Systems Branch
(MLQD)**

**Force Protection
Branch
(MLQF)**



Force Protection Branch



MISSION

To develop advanced technologies and systems that will protect the men and women serving in defense of our country, and thereby improve our nation's antiterrorism, counterterrorism, and force protection posture.

RESEARCH AREAS

- Robotics
- Engineering Mechanics
- Explosive Effects
- Explosive Operations and Support
- Asymmetric Threat Protection



Background



- **Historically services and DARPA have experimented individually with UGVs and UAVs, however challenges still exist:**
 - **How do you control past 1-2 km line of sight**
 - **How do you employ/deploy these UGVs**
- **USSOCOM Pathfinder ACTD expands use of UGVs to conduct airfield survey and other RSTA type missions in denied areas.**
- **USAF AFRL is leading the technology in the establishment of a common interface for all unmanned systems called Joint Architecture for Unmanned Systems (JAUS).**
- **No service is actively putting the entire picture of**

placement/Control of UGVs from UAVs can not only support urban operations, but also aid in our search in caves and other denied areas



Mission Statement



Demonstrate the military applications to deliver an Unmanned Ground Vehicle (UGV) from an Unmanned Aerial Vehicle (UAV) and to use a communications relay, on a UAV, to extend the range of control beyond current system ranges for the UGV in an urban environment.



Participants

- **UAV Battlelab**
- **AFRL/MLQF**
- **USSOCOM**
- **AFSOC**
- **720th Special Tactics Group**
- **USN Coastal Systems Station**
- **6th Ranger Training Battalion**
- **DRS Unmanned Technologies**
- **Wintec, Inc.**



Objectives



- **Demonstrate communications solution to remotely control a UGV and its sensors beyond current system ranges (1-2 km).**
 - **Demonstrate the delivery of a UGV by a UAV into a desired area of interest.**
 - **Demonstrate effectiveness of JAUS architecture to control multiple (two) UGVs through a communications relay.**
 - **Demonstrate effectiveness of UAV/UGV integration to provide persistent target information for the Intelligence Preparation of the Battlespace.**
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Primary Objective 1

- **Demonstrated communications solution to remotely control a UGV and its sensors beyond current system ranges of the UGV Operator Control Unit (OCU).**



Sentry HP UAV
w Comm-Repeater Payload



ARTS and Matilda UGVs
perform in Joint Multi-UGV
Mission



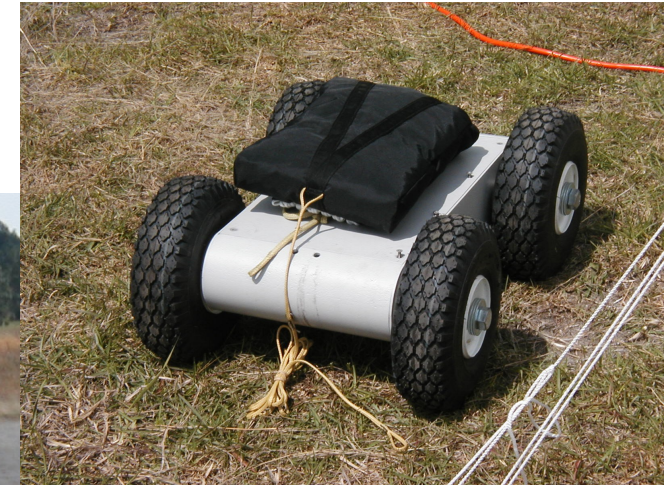
UGVs controlled from
Operator Command Pos



Primary Objective 2



- **Demonstrated the delivery of a UGV by a UAV into a desired area.**



EEL UGV w Chute

EEL Carried by Sentry HP UAV



EEL Released from UAV, Chute Deployed



Primary Objectives 3



- Demonstrate effectiveness of JAUS architecture to control multiple (two) UGVs through a communications relay.



Matilda UGV Deployment from ARTS UGV





Primary Objective 4



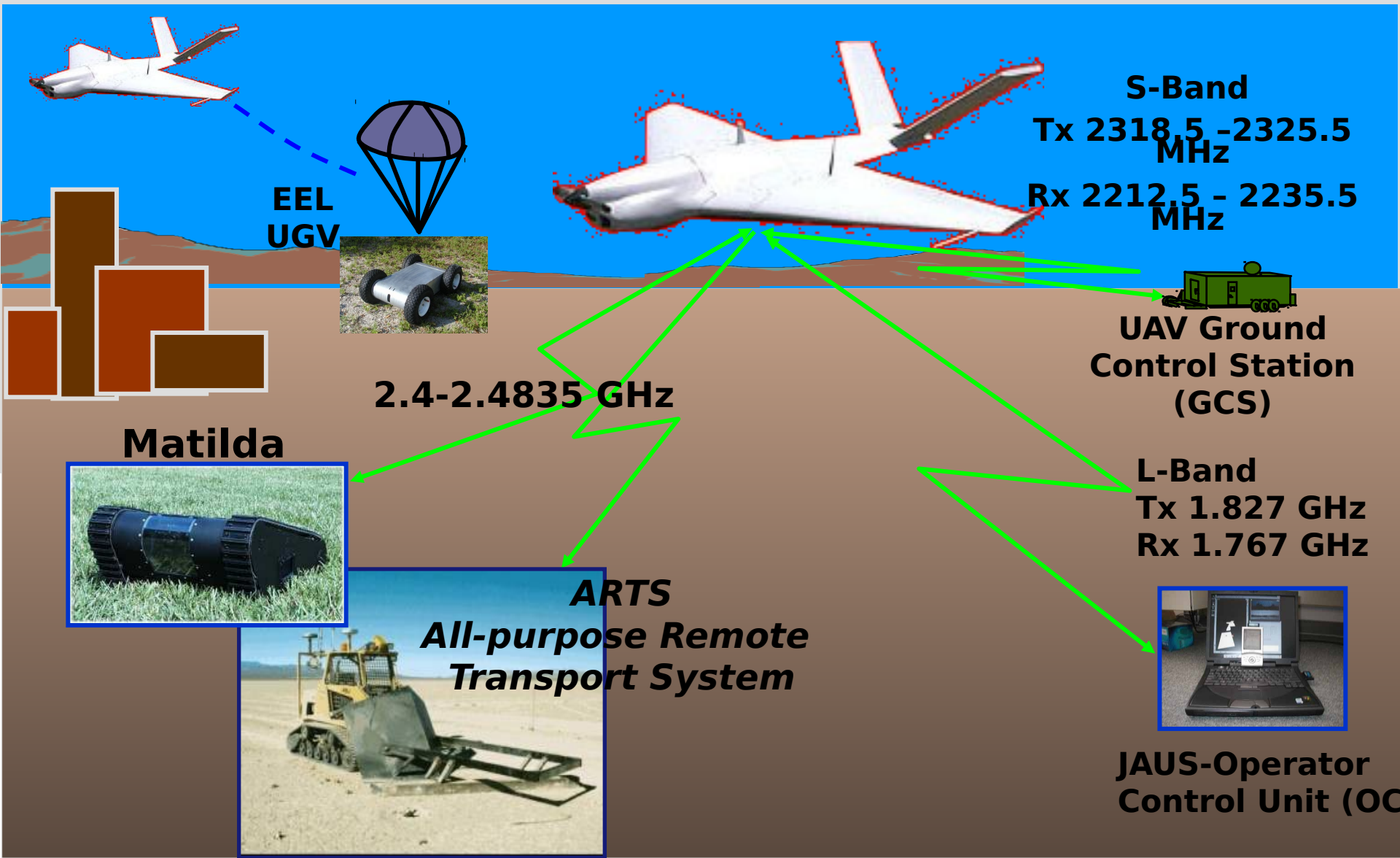
- **Demonstrated effectiveness of UAV/UGV integration to provide persistent target information for the Intelligence Preparation of the Battlespace.**



Target Intel and Matilda Recovery by ART



Systems Architecture





Joint Architecture for Unmanned Systems (JAUS)



- **JAUS: Interface Specification defining message sets for the command and control of unmanned systems. Open architecture approach allows multiple developers from different organizations to develop systems to a common set of standards.**
- **Goal: Reduce life cycle costs of unmanned systems (AIR, GROUND, SEA, STATIONARY) through interoperable/interchangeable component architecture.**



SENTRY HP UAV



The SENTRY HP UAV System



LAUNCHER/TRANSPORTER

- EXPERIENCE
- PRODUCTION CAPABILITY
- LOGISTICS SUPPORT
- INTEGRATION ABILITY



HUMVEE CONFIGURED
GCS/GDT

GROUND DATA TERMINAL



EO/IR
PAYLOAD



HUMVEE CONFIGURATION GCS



- Sentry HP UAV
 - Proven system with multiple agency users
 - Demonstrated capability to airdrop up to 75 lbs on an airfield
 - Demonstrated capability for multiple UAV control and hand over to GCS
 - Quiet and small
- 4-6 Hrs duration
- Autonomous 100 waypoint navigation



Expendable Electric Landrover (EEL)



- Small, rugged, robotic sensor platform.
- Wide variety of sensors and includes integrated color video.
- EEL can be tele-operated or fully autonomous.
- COTS electronics are utilized for the control system. Internal orientation sensors allow the system to operate correctly even if flipped upside down.
- EEL is 28 inches long by 18 inches wide and weighs only 50 pounds.





All-purpose Remote Transport System (ARTS)

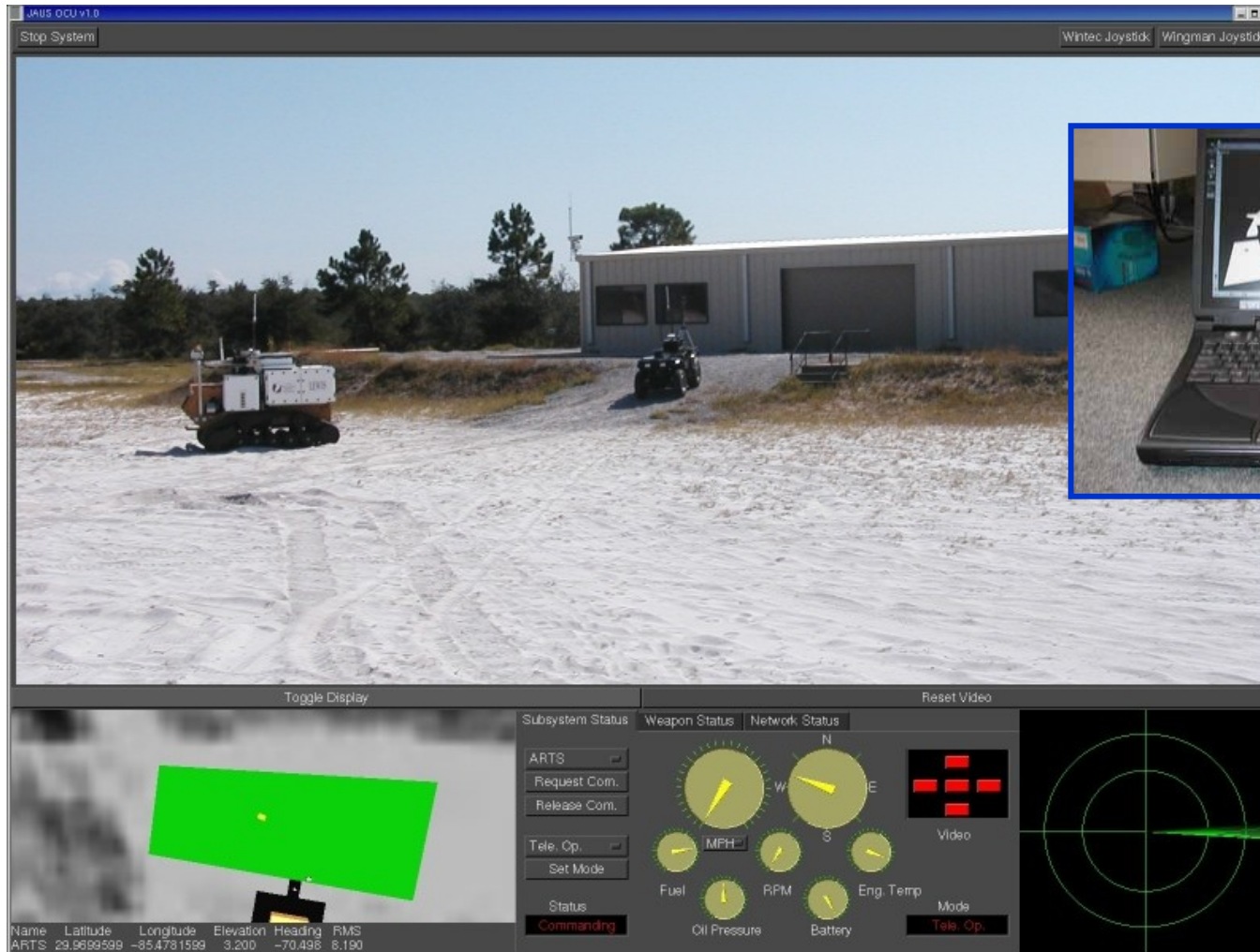


- **Commercially available, low ground pressure, rough-terrain, hydraulically powered, posi-tracked tractor.**
- **Provides stand-off solution for EOD operators to locate, remove, and neutralize unexploded ordnance (UXO) and improvised explosive devices (IEDs).**
- **Quick attachment mounting plate capable of employing and integrating various tools and attachments for a wide variety of missions.**



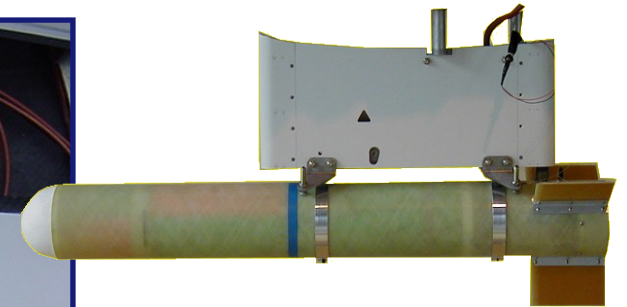
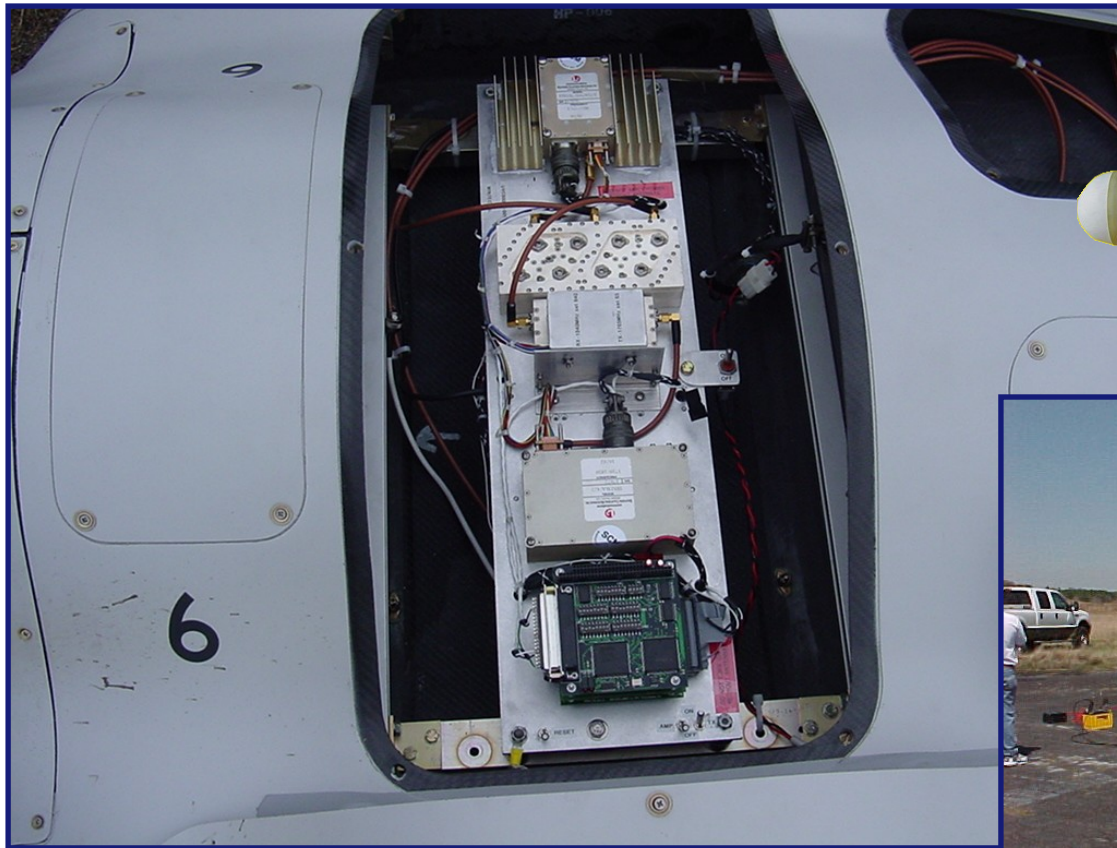


Operator Control Unit (OCU)



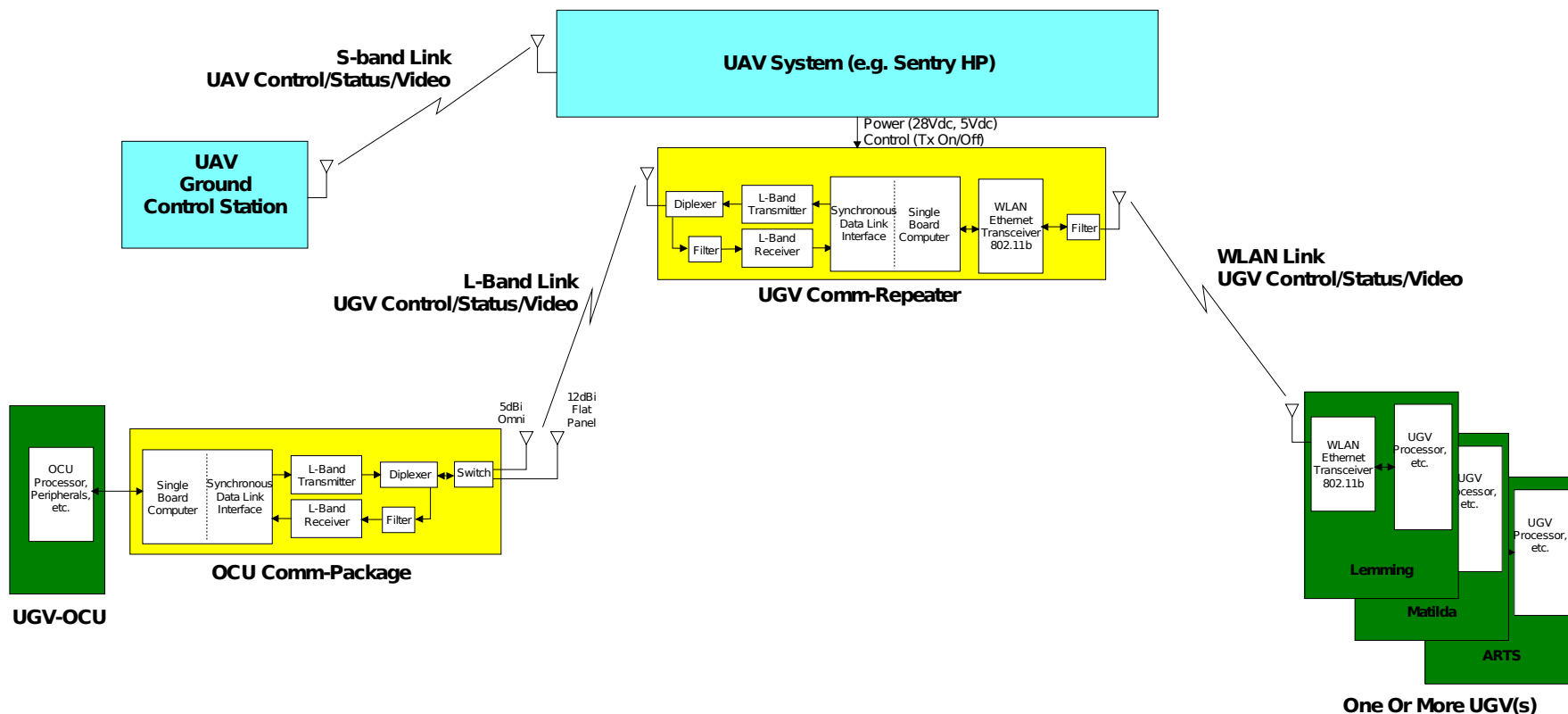


Communications Relay





UV Comm-Repeater System Block Diagram

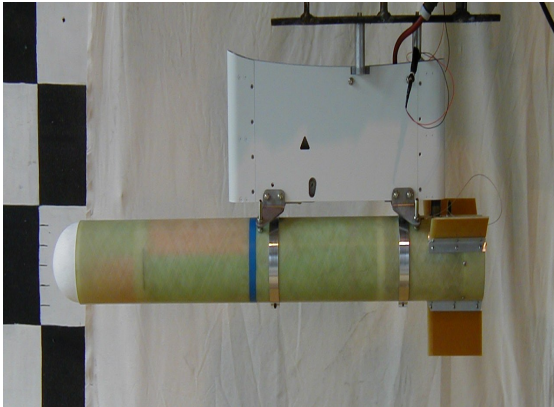
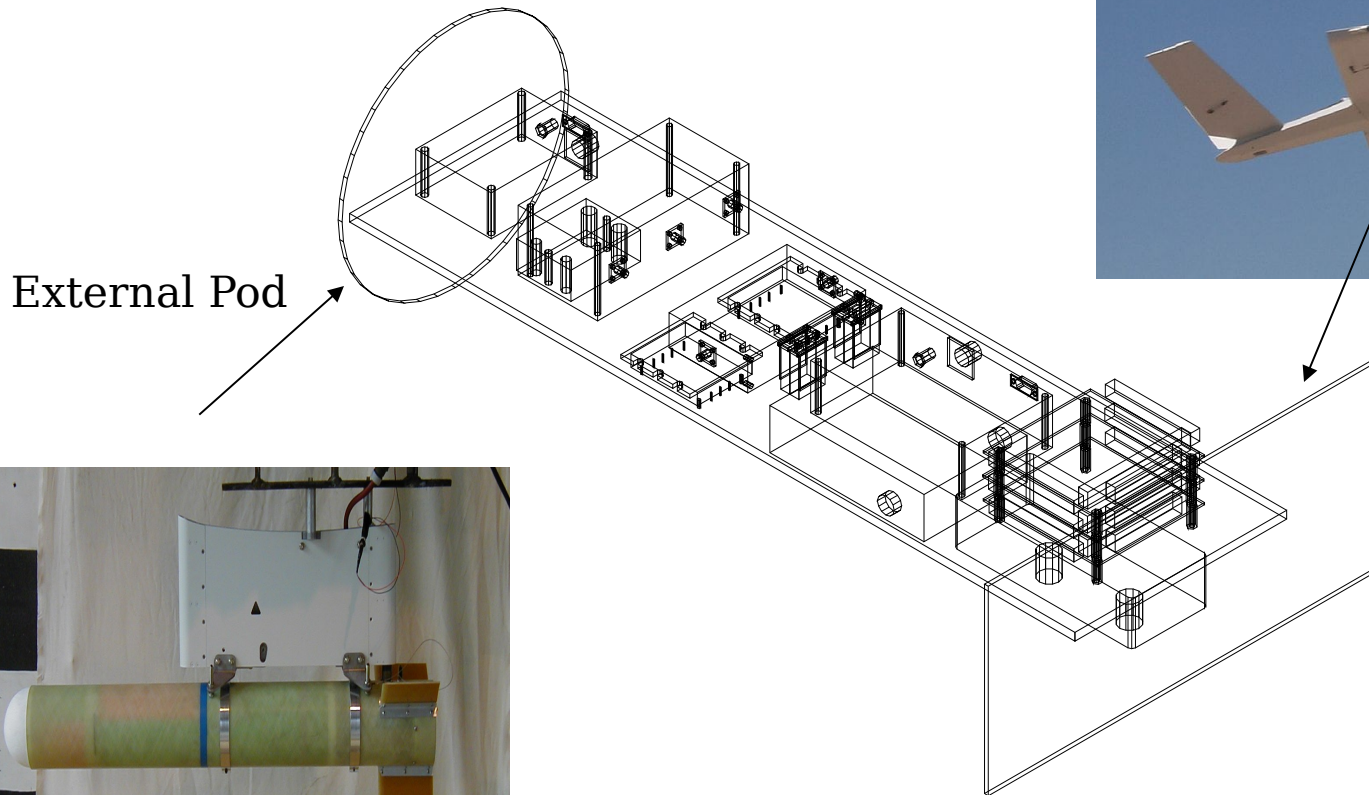




UV Comm-Repeater Payload



- Components mounted top and bottom of 24"x7"AL plate, 0.25" thick
- Designed for dual installation

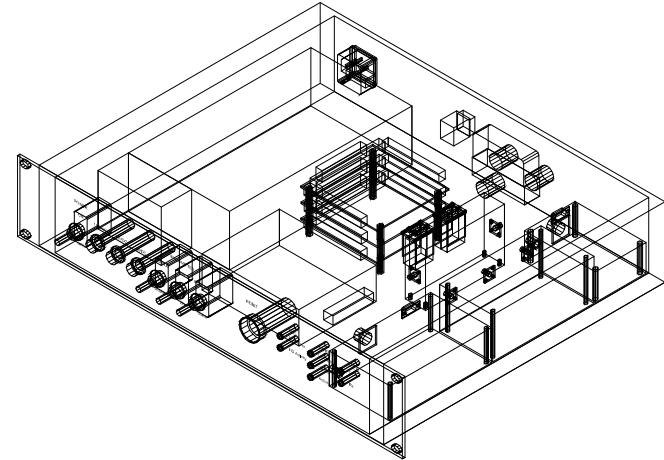




OCU Comm-Package Assembly



- **19" Rack Mount Flexi-Box, 3.5" Front Panel Height**
- **Front Panel Control/Monitor**
- **Rear Panel I/O**



- **Power: 115VAC/60Hz**
- **Size: 3.5" x 19" x 14.5" (HxWxD)**
- **Weight: < 25lbs**
- **Ether Data I/F to OCU**

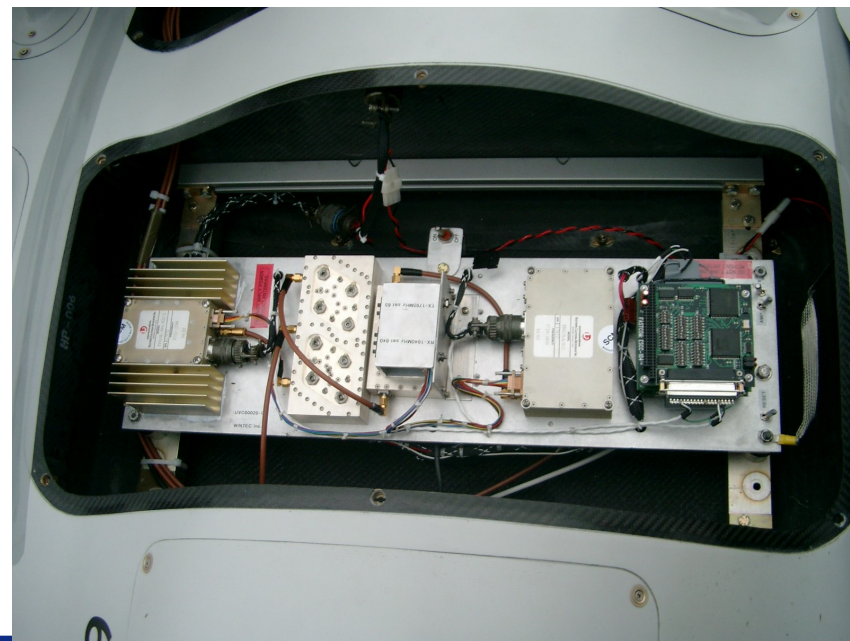


UAV Comm-Repeater Payload Integration



- Comm-Repeater Payload shown mounted in Sentry HP UAV-6
- Payload accessible from top and bottom of UAV

- Power: 28Vdc
- Plate Size: 24" x 7" (LxW)
- Volume: 5" x 7" x 24" (HxWxD)
- Weight: < 15lbs





Integration Tests Mineral Wells, TX







UGV Drop







Demonstration Results



- Control UGV beyond current system ranges (1-2km) with UAV relay
- Emplace a UGV with a UAV into desired area
- Control two UGVs through UAV relay
- Provide target information to UGV operator



Relay allows control of UGVs out to 26 km

 **Accomplished**  **Partial Success**  **Unsuccessful**



UAV/UGV Video



